

CLAIMS

Therefore, at least the following is claimed:

1. A digital subscriber line (DSL) transceiver, comprising:
 - 2 a pulse amplitude modulation (PAM) transmitter;
 - 3 a fractional encoder associated with the PAM transmitter, the fractional encoder configured to encode a non-integer number of bits for each word to be transmitted by
 - 4 the PAM transmitter; and
 - 5 a constellation encoder configured to encode each word containing the non-
 - 6 integer number of bits into a signal space constellation to be transmitted by the PAM
 - 7 transmitter, and where each signal space constellation comprises a symbol.
- 1 2. The transceiver of claim 1, wherein the signal space constellation is generated by the PAM transmitter.
- 1 2 3. The transceiver of claim 1, wherein the fractional encoder further comprises a modulus converter.
- 1 2 4. The transceiver of claim 1, wherein the fractional encoder further comprises a shell mapper.
- 1 2 5. The transceiver of claim 1, wherein the fractional encoder further comprises a constellation switcher.

1 6. The transceiver of claim 1, wherein each symbol is transmitted using a
2 single dimensional signal space constellation.

1 7. The transceiver of claim 1, wherein each symbol is transmitted using a
2 multi-dimensional signal space constellation.

1 8. The transceiver of claim 1, further comprising a trellis encoder associated
2 with the constellation encoder.

1 9. The transceiver of claim 1, wherein the fractional encoder is configured
2 to collect an integer number of bits $S*K$, over a frame comprising several symbol
3 periods S , and is configured to encode the frame of $S*K$ bits for transmission at a
4 fractional bit rate of K bits per symbol.

1 10. The transceiver of claim 9, wherein the fractional encoder is configured
2 to convert the $S*K$ bits of the frame into S integers, each of arithmetic base M , where M
3 corresponds to a plurality of PAM signal levels.

1 11. The transceiver of claim 1, further comprising a fractional decoder
2 configured to decode a received symbol into a non-integer number of bits.

1 12. The transceiver of claim 11, wherein the fractional decoder is a modulus
2 converter.

1 13. A method for encoding fractional bit rates using pulse amplitude
2 modulation (PAM), the method comprising the steps of:
3 providing a PAM modulator;
4 using the PAM modulator to generate a transmit signal; and
5 encoding the transmit signal with a modulation symbol representing a non-
6 integer number of bits, wherein the sum of the bits over a plurality of symbol times
7 results in an integer number of bits.

1 14. The method of claim 13, wherein the encoding step includes modulus
2 conversion.

1 15. The method of claim 13, wherein the encoding step includes shell
2 mapping.

1 16. The method of claim 13, wherein the encoding step includes constellation
2 switching.

1 17. The method of claim 13, wherein the modulation symbol is encoded into
2 a multi-dimensional signal space constellation.

1 18. The method of claim 13, wherein the modulation symbol is encoded into
2 a single dimensional signal space constellation.

1 19. The method of claim 13, further comprising the step of trellis encoding
2 the modulation symbol.

1 20. The method of claim 13, further comprising the steps of:
2 collecting an integer number of bits $S*K$, over a frame comprising several
3 symbol periods S ; and
4 encoding the frame of $S*K$ bits for transmission at a fractional bit rate of K bits
5 per symbol.

1 21. The method of claim 20, further comprising the step of converting the
2 $S*K$ bits of the frame into S integers, each of arithmetic base M , where M corresponds
3 to a plurality of PAM signal levels.

1 22. A digital subscriber line (DSL) transceiver, comprising:
2 means for providing a PAM modulator;
3 means for using the PAM modulator to generate a transmit signal, the transmit
4 signal including a plurality of transmit symbols; and
5 means for encoding each of the transmit symbols with a non-integer number of
6 bits, wherein the sum of the bits over a plurality of transmit symbols results in an integer
7 number of bits.

1 23. The transceiver of claim 22, wherein the encoding means includes
2 modulus conversion means.

1 24. The transceiver of claim 22, wherein the encoding means includes shell
2 mapping means.

1 25. The transceiver of claim 22, wherein the encoding means includes
2 constellation switching means.

1 26. The transceiver of claim 22, wherein the transmit symbol is encoded into
2 a single dimensional signal space constellation.

1 27. The transceiver of claim 22, wherein the transmit symbol is encoded into
2 a multi-dimensional signal space constellation.

1 28. The transceiver of claim 22, further comprising means for trellis encoding
2 each of the transmit symbols.

1 29. The transceiver of claim 22, further comprising:
2 means for collecting an integer number of bits $S*K$, over a frame comprising
3 several symbol periods S ; and
4 means for encoding the frame of $S*K$ bits for transmission at a fractional bit rate
5 of K bits per symbol.

1 30. The transceiver of claim 29, further comprising:
2 means for converting the $S*K$ bits of the frame into S integers, each of
3 arithmetic base M , where M corresponds to a plurality of PAM signal levels.